

## 7.0 RECOMMENDED SITE CORRECTIVE MEASURES

Potential Corrective Action technologies meeting threshold screening criteria in **Section 5.0** were evaluated in **Section 6.0** pursuant to the seven balancing criteria to further screen the list of technologies to those most appropriate for SWMU Group A, Main Plant Area (MPA) SWMUs and Site-wide Groundwater (see table below). Section 6.0 retained technologies have been grouped into combinations to form Site Corrective Measures Alternatives. The Site Corrective Measures Alternatives have been evaluated and the best-balanced Site Corrective Measures Alternative recommended. The rationale for the recommended Corrective Measures Alternative is discussed pursuant to attainment of Site CAOs and media specific clean-up goals (see **Sections 4.0 & 4.1** respectively); its relationship to the balancing criterion and statutory requirements vs. other alternatives; and consistency with RCRA Guidance and relevant Corrective Action precedent.

Section 6.0 Retained Corrective Action Technologies	
<b>SWMU Group A</b>	Institutional Controls
	Caps/Covers
	Perched water trench
	Slurry Wall Containment Barrier
<b>Main Plant Area</b>	Institutional Controls
	Caps / Covers - SWMU 27
	ISCO TTD - SWMU Groups C & D and SWMUs 21 & 27 (TEST SWMU 27)
	ISB TTD - SWMU Groups C & D and SWMUs 21 & 27 (TEST SWMU 27)
	On-Site Incineration -SWMU 27
	Off-Site Incineration - SWMUs 21/27
	Off-Site Landfill - SWMUs 21, 27
<b>Site-wide Groundwater</b>	Enhanced Site-wide Groundwater Containment and Treatment
	Institutional Controls

### NOTES

TTD - Tiered Technology Demonstration

There are twenty to more than forty combinations that could be derived from the list of retained technologies for Site Corrective Measures Alternatives, dependent on how Institutional Controls are treated. The Site Corrective Measures Alternatives defined below represent only six technology combinations, from which a recommended Site Corrective Measure is to be made. There are other combinations possible, but these were selected to represent a broad range for each Site Area (i.e. SWMU Group A, MPA and Site-wide Groundwater) for comparative purposes. The comparative analysis of the Site Corrective Measures alternatives, rather than the specific groupings of technologies making up each alternative, represents the primary value of this section.

Table 7.0-1 presents a summary spreadsheet of the technology arrays for the following alternatives and may be a useful guide for Section 7 review.

**Site Corrective Measures Alternative #1**

- SWMU Group A – Institutional Controls (ICs), Cap (RCRA) and perched water collection trench;
- MPA SWMUs - Institutional Controls (ICs);
- Site-wide Groundwater - Institutional Controls (ICs) and Enhanced Site-wide Groundwater Containment and Treatment.

○ **Site Corrective Measures Alternative #2**

- SWMU Group A – Institutional Controls (ICs), Cap (Soil) and perched water collection trench;
- MPA SWMUs - Institutional Controls (ICs);
- Site-wide Groundwater – Institutional Controls (ICs) and Enhanced Site-wide Groundwater Containment and Treatment.

○ **Site Corrective Measures Alternative #3**

- SWMU Group A – Institutional Controls (ICs), Cap (Soil) and perched water collection trench
- MPA SWMUs – Institutional Controls (ICs) and TTD for ISCO & ISB (SWMU Groups C & D and SWMUs 21 & 27)
- Site-Wide Groundwater – Institutional Controls (ICs) and Enhanced Site-wide Groundwater Containment and Treatment.

○ **Site Corrective Measures Alternative #4**

- SWMU Group A – Institutional Controls (ICs), Cap (RCRA) and Slurry Wall Containment Barrier
- MPA SWMUs – Institutional Controls (ICs) and Tiered Technology Demonstration (TTD) for ISB / ISCO (SWMU Groups C & D and SWMUs 21 & 27)
- Site-Wide Groundwater – Institutional Controls (ICs) and Enhanced Site-wide Groundwater Containment and Treatment

○ **Site Corrective Measures Alternative #5**

- SWMU Group A – Institutional Controls (ICs), Cap (RCRA) and Slurry Wall Containment Barrier

- MPA SWMUs – Institutional Controls (ICs) and Off site incineration or landfill for SWMUs 21 & 27; Tiered Technology Demonstration (TTD) for ISB / ISCO (SWMU Groups C & D)
- Site-Wide Groundwater – Institutional Controls (ICs) and Enhanced Site-wide Groundwater Containment and Treatment
- **Site Corrective Measures Alternative #6**
  - SWMU Group A – Institutional Controls ICs, Cap (Soil) and Slurry Wall Containment Barrier
  - MPA SWMUs - Institutional Controls ICs and Off site incineration or landfill for SWMUs 21 & 27; Tiered Technology Demonstration (TTD) for ISB / ISCO (SWMU Groups C & D)
  - Site-Wide Groundwater - Institutional Controls (ICs) and Enhanced Site-wide Groundwater Containment and Treatment

## 7.1 DESCRIPTION OF SITE CORRECTIVE MEASURES ALTERNATIVES

The technologies comprising each Site Corrective Measures Alternative have been thoroughly reviewed in previous sections of the CMS. Following are listings and brief summaries only of the technologies employed by each alternative for each of the Site areas.

### 7.1.1 SITE CORRECTIVE MEASURES ALTERNATIVE #1

- SWMU Group A – Institutional Controls (ICs), Cap (RCRA) and perched water collection trench;
- MPA SWMUs - Institutional Controls (ICs);
- Site-wide Groundwater - Institutional Controls (ICs) and Enhanced Site-wide Groundwater Containment and Treatment

Alternative 1 consists of a RCRA-compliant landfill cap over SWMU Group A in combination with a perched water collection drain, as well as an Enhanced Site-wide Groundwater Containment and Treatment System and Institutional Controls (ICs) for the MPA SWMUs. Major components of Alternative #1 include the following:

- **SWMU Group A**
  - Ash lagoon backfill to achieve sloped subgrade (min. 2%) , approximately 2,000 cy
  - Site grading and subgrade fill to achieve min. 2% grade (avg. 1 ft thick over 7 acres- 11,000 cy)
  - RCRA-compliant landfill cap- geotextile subbase, HDPE membrane (80 mil thick), geosynthetic drainage net, final cover soil (2 ft thick) and vegetation,

- Interceptor collection trench installed to approximately 620 ft-msl around the west, south and east perimeter of SWMU Group A, approximately 1600 linear ft. The trench includes a perforated HDPE pipe and coarse aggregate to a minimum of 10 feet depth, with five (5) collection sumps with submersible pumps that discharge to a central lift station for conveyance to the on-site wastewater treatment system. Average flow from the system is estimated to be approximately 4 gpm.
- **MPA SWMUs - ICs including:**
  - Plant safety plan with descriptions of SWMU and contaminants and safety protocols and restrictions for working within or near the SWMUs,
  - Hazard communication plan for worker activities potentially exposed to SWMU waste constituents, including periodic worker and contractor training as necessary, with a general plant facility plan and mapping notations for SWMU conditions for reference purposes,
  - Written procedure for handling contaminated soil.
  - Land Use Deed restrictions that run with the land and/or recordation with Miss Utility of West Virginia.
- **Site-wide Groundwater – The Enhanced Site-wide Groundwater Containment and Treatment system is composed of:**
  - ICs including local / state restrictions on well drilling and water use on Site; covenants running with the Site deed restricting groundwater drilling and use; enforceable conditions in the Site RCRA Corrective Action Permit preventing the use of groundwater except for approved purposes.
  - Optimized groundwater recovery system. For cost evaluation purposes, the enhanced system is assumed to consist of the three (3) current recovery wells and two additional recovery wells to further assure groundwater containment site-wide, assumed to recovery an estimated additional 300 gpm. The assumed new pumping rate is an increase of 70% from the current rate of 474gpm to an estimated 774 gpm. The actual design of the enhanced groundwater recovery system will be defined by an effectiveness modeling study to optimize the pumping scheme. Variables to be evaluated include pumping rate and well locations, including relocating the current three pumping wells.
  - Treatment of all recovered groundwater in the Bayer on-site biological wastewater treatment plant. The assumed final recovery rate of the Enhanced Site-wide Groundwater Containment and Treatment system for cost evaluation purposes is 774 GPM.

- o Additional monitoring wells in the alluvial aquifer. For cost evaluation purposes, the number of additional monitoring wells is assumed to be four (4). The actual number and location of monitoring wells for the Enhanced Site-wide Groundwater Containment and Treatment system will be addressed in the effectiveness modeling study.

These technology components have been described in more detail in Section 6.0.

### 7.1.2 SITE CORRECTIVE MEASURES ALTERNATIVE #2

Corrective Measures Alternative 2 differs from Alternative 1 in SWMU Group A only by replacement of the RCRA cap with a "Soil cap" over SWMU Group A. Alternative 2 consists of:

- o SWMU Group A – ICs, Cap (**Soil**) and perched water collection trench
- o MPA SWMUs - ICs;
- o Site-wide Groundwater – ICs and Enhanced Site-wide Groundwater Containment and Treatment

The cap for SWMU Group A analyzed in Section 6.0 was a RCRA cap that included a synthetic membrane (80-mil HDPE). The differences between Soil and RCRA capping technology are considered minor, and include long-term effectiveness and cost. The soil cap would consist of a fine-grained clayey soil compacted to achieve a low permeability barrier. The net infiltration into the underlying SWMU for the soil cap is expected to be slightly greater than a RCRA synthetic membrane cap. However, the difference with respect to leaching of SWMU constituents and effects on the alluvial aquifer are expected to be minor. An estimate of net annual leakage through each of the cap types from rainfall infiltration can be prepared using the EPA HELP Model. For the Site, the annual percolation rate for each of the cap types is estimated as follows:

Cap Type	Annual Rainfall, in.	Net Infiltration, in.	Cap Percolation, in.
Soil ( $K < 1 \times 10^{-6}$ cm/sec)	44	12	0.5
RCRA with HDPE	44	12	0.1

If differential settling were to occur, the long-term effectiveness of the soil cap may be less than a RCRA cap that includes a synthetic membrane. After more than 20 years of settling however, the potential for differential settling is assessed to be low. Additional settlement could occur from waste consolidation and to a lesser degree, organic degradation. Underlying settlement could potentially affect cap geodrain failures and secondary permeability increases in the low permeability soil layer, thus increasing cap percolation over the long-term. A synthetic membrane could be less affected by differential settlement because of its material tensile

strength and elongation properties. This effect, should it occur, is expected to be minor with respect to its affect on leaching of SWMU constituents to the alluvial aquifer.

### 7.1.3 SITE CORRECTIVE MEASURES ALTERNATIVE #3

Alternative 3 adds ISB Tiered Technology Demonstrations (TTD) for MPA SWMUs to Alternative 2. Alternative 3 consists of:

- o SWMU Group A – ICs, Cap (Soil) and perched water collection trench
- o MPA SWMUs – ICs and TTD for ISB and / or ISCO (SWMU Groups C & D and SWMUs 21 & 27)
- o Site-Wide Groundwater – ICs and Enhanced Site-wide Groundwater Containment and Treatment

The ISB / ISCO TTDs would include:

- ✓ Up to five (5) demonstration test areas in the MPA conducted over a total 5 to 10-year period;
- ✓ Each test area would involve either an ISCO or ISB pilot test, nominal 10,000 ft<sup>2</sup> area, in selected SWMU areas throughout the MPA that are most practically representative of SWMU conditions. The proposed test areas include SWMU 27, SWMU 21 and up to (3) other SWMU "hot spots".
- ✓ Future full-scale ISCO or ISB applications in the MPA will be based on the results of the TTDs.

The tiered technology demonstration (TTD) program will involve tests at selected SWMU areas in the MPA that are most representative of Site conditions. Implementation of the TTD program will provide site-specific data on the feasibility of ISCO and ISB pursuant to the MPA COIs and design data for estimating oxidant and/or biosupplement suitability, optimum dosage rates, application methods, and monitoring protocols.

The TTDs will be designed to be pilot-scale, in-situ tests for either ISCO or ISB within the MPA SWMUs. If the TTDs are shown to be successful, the full-scale application of either ISCO or ISB would be implemented on a selective SWMU basis (excluding SWMU Group B), depending on practical considerations in the plant operating areas as described in Section 6.0. Full-scale application of ISCO and/or ISB technologies would be expected to effect significant reductions in SWMU constituent levels and mass loading to the Alluvial Aquifer. These reductions would result in an acceleration of long-term improvements in Alluvial Aquifer water quality. Quantification and predictions of aquifer water quality improvements would be assessed after completion of the TTD testing.

Compared to Alternatives 1 and 2, successful demonstration and implementation of ISB and/or ISCO as source treatments for MPA SWMUs would potentially result in faster reduction of COI concentrations in Site groundwater.

#### 7.1.4 SITE CORRECTIVE MEASURES ALTERNATIVE #4

Alternative 4 adds a SWMU Group A Slurry wall Containment Barrier to Alternative 3 and eliminates the SWMU Group A perched water collection trench. Alternative 4 consists of:

- o SWMU Group A – ICs, Cap (RCRA) and Slurry Wall Containment Barrier
- o MPA SWMUs – ICs and TTD for ISB and / or ISCO (SWMU Groups C & D and SWMUs 21 & 27)
- o Site-wide Groundwater - ICs and Enhanced Site-wide Groundwater Containment and Treatment

As described in more detail in Section 6, for evaluation purposes, the soil-bentonite slurry wall is assumed to be installed to the bottom of the alluvial aquifer (~50-60 ft-bgs to bedrock) around the entire perimeter (~ 2500 LF) of SWMU Group A. The area within SWMU Group A requiring the slurry wall barrier covers approximately 7-acres and extends approximately 2500 lineal ft.

#### 7.1.5 SITE CORRECTIVE MEASURES ALTERNATIVE #5

Alternatives 5 and 6 differ from Alternatives 3 & 4 by using excavation and removal of MPA SWMUs 21 & 27 vs. ISCO and/or ISB TTDs. Alternative 5 consists of:

- o SWMU Group A – ICs, Cap (RCRA) and Slurry Wall Containment Barrier
- o MPA SWMUs – ICs; Off site incineration or landfill for SWMUs 21 & 27; and ISB and / or ISCO (SWMU Groups C & D).
- o Site-wide Groundwater - ICs and Enhanced Site-wide Groundwater Containment and Treatment

Alternative 5 differs from Alternative 4 in the MPA only, where SWMUs 21/27 are removed and disposed of off-site either by incineration or at a landfill.

#### 7.1.6 SITE CORRECTIVE MEASURES ALTERNATIVE #6

Alternative 6 differs from Alternative 5 in SWMU Group A only, where the RCRA cap is replaced with a soil cap. Alternative 6 consists of:

- o SWMU Group A – ICs, Cap (Soil) and Slurry Wall Containment Barrier.
- o MPA SWMUs – ICs; Off-site incineration or landfill for SWMUs 21 & 27; and ISB and / or ISCO (SWMU Groups C & D).
- o Site-wide Groundwater – ICs and Enhanced Site-wide Groundwater Containment and Treatment.

#### 7.1.7 COMMON ELEMENTS AND DISTINGUISHING FEATURES OF EACH ALTERNATIVE

At sites where contaminants are left in place at levels that do not allow unrestricted use, Institutional Controls (ICs) to manage land use are used to ensure that the remaining COIs do not pose an unacceptable risk to human health or the environment. ICs consist of administrative, engineering and/or physical controls. Since wastes and COI affected soils and

groundwater will continue to be managed in place long-term, ICs are included as an element of all alternatives, for all areas (i.e. SWMU Group A, MPA SWMUs and Site-wide Groundwater). The specific administrative, engineering and/or physical controls employed will differ somewhat, dependent on the final selected array of Corrective Measures.

All of the alternatives have the following additional common elements:

- o Hydraulic containment of Site groundwater;
- o Restoration of Site groundwater over time by extraction of the contaminated groundwater, treatment of the recovered water to remove the COIs, and the natural replacement of the affected groundwater with unaffected water via recharge and direct infiltration from precipitation;
- o Cap/cover for SWMU Group A;
- o Monitoring of Site groundwater to confirm containment at all times and restoration over time; and
- o Monitoring of off-site drinking water wells to verify the absence of Site COIs and protection of human health

Alternatives 3 & 4 address SWMU sources via treatment, providing the potential for development and implementation of innovative, cost-effective technologies to accelerate restoration of Site-wide Groundwater beyond the rate being achieved with groundwater pump and treat technology alone.

Alternatives 4, 5 and 6 provide redundant, physical containment of SWMU Group A via installation of a slurry wall to bedrock in addition to site-wide hydraulic containment.

Alternatives 5 & 6 employ source removal to potentially enhance the rate of restoration of Site-wide Groundwater.

#### **7.1.8 LONG-TERM RELIABILITY OF CORRECTIVE MEASURES ALTERNATIVES**

The major technology included in all Site Corrective Measures Alternatives to ensure the continued protection of human health and the environment is hydraulic containment of groundwater by pumping and treating. This technology has been successfully and reliably implemented and demonstrated at the Site for over 20 years. Use of the Enhanced Site-wide Groundwater Containment and Treatment technology in all Site Corrective Measures Alternatives should be highly reliable as well.

The SWMU Group A RCRA Cap technology utilized in Alternatives 1, 4 & 5 as well as soil cap technology employed in Alternatives 2, 3 & 6 have been thoroughly designed and field tested in multiple situations. Reliability therefore is expected to be good for alternatives utilizing either of these technologies. The wastes associated with SWMU Group A have some unique characteristics which may create some settling issues to be dealt with in the cap design. If

potential differential settling problems are manifested in SWMU Group A, the soil cap proposed in Alternatives 2, 3 & 6 will be somewhat more susceptible initially to those problems, but may be easier to repair and maintain if problems do occur. Both the RCRA and Soil Caps will require comparable levels of routine maintenance to ensure that adequate vegetation cover is established and maintained.

Alternatives 4, 5 and 6 employ a Slurry Wall Containment Barrier for SWMU Group A. Long term reliability for slurry walls in SWMU Group A would be expected to be reasonable based on the COIs that are known to be present.

Alternatives 5 & 6 employ excavation and removal for MPA SWMUs 21 & 27. This is not expected to affect the long term reliability for these alternatives.

Overall, Alternatives 1 & 2 would be expected to have good long-term reliability because they employ only technologies that have been successfully demonstrated long-term under site-specific conditions. Alternative 3 would be expected to exhibit high long-term reliability as well. Even though it introduces a new source control technology, the technology would be introduced in phases pursuant to successful long-term testing to demonstrate performance under site-specific conditions. Long-term reliability of Alternatives 4, 5 and 6 would be expected to be good but less than Alternatives 1, 2 & 3. This is based on the technical issues discussed earlier with installation and maintenance of the SWMU Group A slurry wall.

## **7.2 COMPARATIVE ANALYSIS OF ALTERNATIVES**

This comparative analysis section discusses the seven balancing criterion and how well each Site Corrective Measures Alternative meets that criterion. The summaries below are summarized in a comparative format in **Table 7.3-3**.

### **7.2.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT**

Overall protection of human health and the environment addresses the ability of an alternative to eliminate, reduce or control threats to public health or the environment through institutional controls, engineering controls, removal or treatment.

Alternatives 3, 4, 5 and 6 meet this criterion to an equal degree of effectiveness. Groundwater pumping and treating technology employed in all of the alternatives has been a primary tool in effectively and reliably protecting public health and the environment over the past twenty (20) years of operation. Alternatives 4, 5 and 6 provide redundant containment of SWMU Group A wastes via the slurry wall. However, all alternatives – based on the incorporation of additional levels of pumping compared to that which has been demonstrated to be effective at protecting public health and the environment over the past twenty (20) years – have redundant pumping capability – adding another layer of protection of public health and the environment.

Excavation and removal of potential sources of COIs from MPA SWMUs 21 & 27 pursuant to Alternatives 5 & 6 is not expected to significantly improve the ability of the Site to achieve this criterion.

Alternatives 1 and 2 also meet this criterion, although less effectively, since other alternatives will provide some additional MPA SWMU treatment of the sources via ISCO and/or ISB; and/or removal of sources via off-site incineration / landfill.

### 7.2.2 LONG TERM EFFECTIVENESS

Long-term effectiveness considers residual risk and the ability of an alternative to maintain protection of human health and the environment over time. This criterion includes consideration of residual risk following the implementation of Corrective Measures and the adequacy and reliability of controls.

Alternatives 3, 4, 5 & 6 provide the best long term effectiveness based on reduction of residual risk by increased pumping and reduced potential for infiltration of leaching medium in SWMU Group A wastes, coupled with utilization of ICs. Alternative 3 has demonstrated via the use of pump and treat technology over the past twenty (20) years the ability to reduce the mobility and volume of wastes and effectiveness in protecting human health and the environment over the long term.

### 7.2.3 REDUCTION OF TOXICITY, MOBILITY OR VOLUME

Reduction of toxicity, mobility or volume of waste considers the alternative's ability to reduce the harmful effects of COIs in the waste, the ability of the COIs to move in the environment and the amount of COIs present, including how the alternatives compare relative to EPA's expectation to use treatment as follows:

"EPA expects to use treatment to address the principal threats posed by a site whenever practicable and cost effective. Contamination that represents principal threats for which treatment is most likely to be appropriate includes contamination that is highly toxic, highly mobile, or cannot be reliably contained, and that would present a significant to human health and the environment should exposure occur." (61 FR 19448)

This Site does not pose any "principal threats". That situation notwithstanding, as reflected in the RFI, all threats to human health and the environmental represented by the Site have been "reliably contained" (61 FR 19448), thus managing and reducing the mobility of Site COIs, for over 20 years - primarily as a result of the pumping and treatment of Site groundwater. In the 20 years of operation of the groundwater pump and treat system, an estimated 4.2 billion gallons of water have been extracted for treatment and 725,000 pounds of organic material have been removed from the alluvial aquifer. Therefore, pursuant to the CAO for groundwater requiring, "...reduction of contaminant levels, as practicable, over time to support reasonably

expected use", there is evidence that the mobility and volume of COIs at the Site is being quantifiably reduced.

The fact that there has been an extended period of time at the Site during which, contaminant volumes are being reduced but without quantifiable reductions in Site COI concentrations in the leaching medium, parallels experiences at many other RCRA and CERCLA pump and treat sites. The concentration in the leaching medium is a function of several other variables characterizing the COIs in addition to the "volume of the source." These variables include solubility and adsorption coefficients, partition gradients, equilibrium concentrations, contact time, etc. The current concentration levels of COIs in Site groundwater do not imply a failure of the pump & treat technology in place at the Site in reducing of toxicity, mobility or volume. Concentration levels of COIs in Site groundwater will decrease with continued containment and removal of COIs from the groundwater via implementation of the Enhanced Site-wide Groundwater Containment and Treatment system and reduction of sources via in-situ treatment.

Therefore, all alternatives are expected to be effective in reducing the volume and mobility of COIs through pumping of the groundwater and treatment ex-situ. Alternatives 5 & 6 reduce volume through removal of MPA SWMUs 21/27. However, Alternatives 3 & 4 employ the development of treatment technologies that have the potential to reduce mobility, volume and toxicity at an accelerated pace - through in-situ treatment. Alternatives 1 & 2 are effective in reducing volume but do not employ any technology for source reduction through treatment.

#### **7.2.4 SHORT-TERM EFFECTIVENESS**

Short-term effectiveness considers the length of time needed to implement a corrective measure and the risks to workers, residents and the environment during the implementation and operation until Site CAOs and media specific goals are achieved. Types of risks and factors to be considered include: fire, explosion, exposure to hazardous substances and potential threats associated with treatment, excavation, transportation and re-disposal or containment of waste material.

All alternatives will require some truck traffic through the community and the Site for the cover materials for SWMU Group A. Alternatives 1 & 2 would have minimal effect on the community and construction / plant workers because activities would be limited to a localized area of the Site. Alternative 3 would present no additional exposure potential to the community and minimal to plant and construction workers to implement the in-situ ISB and / or ISCO TTDs. Alternatives 5 and 6 would have maximum potential impact on the community based on additional truck traffic to transport the wastes from MPA SWMUs 21/27.

Alternatives 4, 5 and 6 would present the greatest potential for worker exposures because of the excavation, processing and re-injection of potentially contaminated soils from SMWU Group A (Slurry wall). Alternatives 5 and 6 would take the longest to implement (i.e. implement actions with potential for exposure).

Alternatives 1 & 2 have the shortest implementation time. Alternative 3 is equally short, excluding the long-term, low exposure potential period for implementation of the TTDs. Alternatives 4, 5 & 6 have the longest implementation time based on the requirement to build the SWMU Group A slurry wall and to remove wastes from MPA SWMUs 21/27.

The potential for environmental impacts during initial implementation are assessed to be essentially equivalent for all alternatives. Alternatives 3 & 4 have the potential to achieve the fastest rate of restoration of Site-wide groundwater – and thereby reduce in a more timely fashion any residual potential for environmental harm from offsite migration of contaminated groundwater – based on development of effective treatment technologies via the TTDs.

#### 7.2.5 IMPLEMENTABILITY

Implementability addresses the technical and administrative feasibility of implementing the Corrective Measures from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other government entities are evaluated.

There are no anticipated insurmountable problems with availability of services and materials for any of the alternatives. All alternatives will incur equivalent levels of interactions with other government entities to develop, obtain approval and implement approved ICs. From a technical design and implementation standpoint, Alternatives 4, 5 & 6 are clearly the most difficult based on the slurry wall containment barrier for SWMU Group A; Alternatives 1 & 2 are the least; and Alternative 3 is slightly more difficult than 1 & 2 given the addition of the ISCO / ISB TTDs.

#### 7.2.6 COSTS

Tables 7.2-1 through 7.2-6 present cost details for each Site Corrective Measures Alternative. Table 7.2-7 presents a summary of those costs. Present value (PV) calculations were completed for each Site Corrective Measures Alternatives (See Tables 7.2-8 through 7.2-13). Table 7.2-14 presents a summary of those present values.

Corrective Measures Alternatives PV costs range from \$12 million for Alternative 2 to \$22 Million for Alternative 5. The difference between Alternatives 1 & 2 is the type of cap on SWMU Group A; between 3 & 4 the type of cap and with / without slurry wall containment on SWMU Group A; and between 5 & 6 – the type of cap on SWMU Group A.

There is some uncertainty in the final costs for Alternates 3 & 4 based on the inclusion in these alternatives the development of ISCO / ISB Technologies. However, future decisions on the degree to which these source treatment technologies will be employed across the Site will be based on the cost effectiveness of these technologies vs. alternatives on-going at that time and their effectiveness in continuing to meet Site CAOs. Alternatives 4, 5 and 6 have a very high degree of uncertainty in PV based on the requirement to install a slurry wall in an operating site with significant underground unknowns (i.e. process lines, sewer lines, utilities, communications,

and wastes) and surface complexities including close proximity to railways, the river and operating units.

### **7.2.7 Community Acceptance**

As discussed in detail in Section 6.0, none of the individual technologies associated with the Site Corrective Measures Alternatives are expected to result in extreme concerns by the community. Effective communication of all alternatives and technologies employed will be critical in the approval process.

### **7.2.8 State Acceptance**

As discussed in detail in Section 6.0, the State is familiar with and expected to be receptive to all proposed technologies incorporated in all alternatives. The viability of - and need for - alternative containment technologies for Site SWMUS, SWMU Group A in particular, is expected to be a concern. This anticipated concern has been addressed by this CMS.

### 7.3 RECOMMENDED SITE CORRECTIVE MEASURES ALTERNATIVES AND RATIONALE

Site Corrective Measures Alternatives technology arrays are presented graphically within **Table 7.3-1**.

Based on the evaluation results for the individual technologies and the combination of technologies represented by Site Corrective Measures Alternatives, the recommended Site Corrective Measure Alternative is as follows:

**SITE CORRECTIVE MEASURES ALTERNATIVE #3** - SWMU Group A Cap (Soil), Main Plant SWMUs Tiered Technology Demonstrations and Site-Wide Alluvial Aquifer Recovery Wells and Onsite Treatment

#### 7.3.1 CMS Criterion Evaluation

Balancing criterion for each alternative discussed in **Section 7.2** is summarized graphically in **Table 7.3-3**. The following conclusions can be drawn relative to recommended Alternative 3;

- Alternative 3 clearly meets all criterion and / or is a very effective alternative relative to all others;
- Alternatives 1, 5 and 6 do not meet all criterion and / or are clearly the least effective alternative for those criterion;
- Alternative 3 is the only alternative that "clearly meets" and / or is assessed to be "very effective alternative" or better – for all criterion.

As a result, Alternative 3 is assessed to be the best balanced Site Corrective Measures Alternative.

#### 7.3.2 Achievement of Site CAOs and Media Specific Cleanup Goals

Both short and long-term CAOs for Site Soils focus on the protection of all potential human receptors from exposure to shallow and sub-surface soils. Corrective Measures Alternative 3 provides protection from potential human exposure via ICs (administrative and physical) and engineered soil cover for SWMU Group A.

Long-term Site CAOs for groundwater require:

- (1) The prevention of unacceptable human exposure to contaminated groundwater. This approved CAO is stated as follows:

Groundwater Cleanup criteria will require reasonable efforts to eliminate or mitigate further releases of contaminants from SWMUs (using the Site boundary as the point of compliance) .... These criteria may include the implementation of institutional or engineering controls.

(2) Actions to address further releases of contaminants to groundwater and reduction of COI levels in groundwater over time. This approved CAO is stated as follows:

"Groundwater cleanup criteria will require ...reduction of contaminant levels, as practicable, over time to support reasonably expected use. These criteria may include the implementation of instructional or engineering controls."

(3) Control of the migration of contaminated groundwater to a level that is protective of surface water. This approved CAO is stated as follows:

"Surface water quality protection is defined as contamination levels that do not exceed WV Water Quality Standards applicable to the receiving stream (using the site boundary as the point of compliance)."

Alternative 3 will effectively attain the long-term groundwater CAOs as follows:

1. Human health will continue to be protected from contaminated groundwater via ICs to prevent potential exposure onsite and via hydraulic containment to prevent the potential for offsite migration. Hydraulic containment will be confirmed with periodic groundwater level measurements.
2. Actions to reduce contaminant levels, as practicable, over time to support reasonably expected use includes extracting the contaminated groundwater and removal of COIs via biological treatment. The development and implementation of ISB / ISCO site-specific treatment technologies has potential to significantly and cost effectively reduce MPA SWMU COI sources. Reduction of contaminant levels in groundwater will be confirmed via periodic measurements of COI concentration in groundwater and documentation of the volume (pounds) of COIs removed from the groundwater via biological treatment (from soils and/or groundwater).
3. Surface water will be protected from contaminated groundwater by hydraulic containment through the pumping of the alluvial aquifer and collection of perched water in SWMU Group A. Protection will be confirmed by periodic testing of groundwater at the POC and comparison to applicable WV Water Quality Standards.

### 7.3.3 Statutory Determination

The recommended Site Corrective Measures Alternative has been reviewed for consistency with statutory requirements related to Protection of Public Health and the Environment; the West Virginia Groundwater Protection Act; Cost Effectiveness; and Preference for Treatment as a Primary Element.

### 7.3.3.1 Protection of Human Health and the Environment

Remedies should be protective of human health and the environment, and maintain protection over time. Alternative 3 will protect human health and the environment through placement of a soil cover over SWMU Group A to prevent exposure through contact with surface and subsurface soils. The entire Site is under the control of Bayer and Institutional Controls developed and implemented by Bayer will prevent unacceptable exposures to Site workers, construction workers and other potential human exposures to shallow and subsurface soil contaminants associated with SWMU Group A and MPA SWMUs. Potential exposure to Site Groundwater and Site recovered groundwater will also be managed with Institutional Controls, including governmental controls such as zoning, ordinances, statutes and building permits; proprietary controls or legal instruments in the chain of title such as negative easements and covenants not to dig or drill; and enforcement tools such as enforceable permits.

The potential for any appreciable off-site migration that could create a potential exposure to Site contaminants to humans or the environment will be controlled by the Enhanced Site-wide Groundwater Containment and Treatment technology and verified on a continuing basis with the Site-wide and off-site monitoring program associated with Alternative 3.

### 7.3.3.2 West Virginia Groundwater Protection Act

The West Virginia Groundwater Protection Act is established by **W. Va. Code §22-12** et seq. ("**ACT**"). The Groundwater Protection Rule is established by **47CSR58** of the Legislative Rules ("**Rule**"). The Act in §22-12-4(b) requires the following pursuant to existing groundwater contamination:

"Where the concentration of a certain constituent exceeds such standard (*defined as maximum contaminant levels permitted for groundwater as established by the Secretary*) due to human-induced contamination, no further contamination by that constituent is allowed and every reasonable effort shall be made to identify, remove or mitigate the source of such contamination and to strive where practical to reduce the level of contamination over time to support drinking water use".

The Rule in **§47-58-8 Remediation** states:

8.1 "The Division has the authority to order persons to conduct remedial actions..."

(8.1.a) "The use of permanent solutions to the maximum extent practical to correct groundwater contaminations is preferred".

(8.1.b) "Cleanup actions shall not rely primarily on dilution and dispersion of the substance if active remedial measures are technically and economically feasible, as determined by the Director".

(8.1.c) "Adequate groundwater monitoring shall be conducted to demonstrate control and containment of the substance. The Director shall specify which parameters should

be monitored in a remedial operation. Groundwater monitoring must continue until results assure adequate remedial action was taken".

The recommended Corrective Measures Alternative will be in compliance with the West Virginia Groundwater Protection Act. As defined in detail in by this CMS, recommended Site-wide Corrective Measures represent "...reasonable efforts ..." to identify, remove or mitigate the source of such contamination and to strive where practical to reduce the level of contamination over time to support drinking water use", as required by the Act. With respect to SWMU Group A where wastes remain in place below the saturated zone, "hydraulic containment can be accomplished by controlling the direction of groundwater flow with capture zones or pressure ridges or physical barriers."<sup>4</sup> Every reasonable effort will be made in the final hydraulic containment design for the Enhanced Site-wide Groundwater Containment and Treatment system to minimizing contact of uncontaminated groundwater with wastes in SWMU Group A, pursuant to the requirements of the Act [§22-12-4(b)]. One objective of the Enhanced Site-wide Groundwater Containment and Treatment design, with respect to SWMU Group A wastes, will be, "... to demonstrate control and containment of the substance", as required by the Rule (8.1.c).

#### 7.3.3.3 Cost Effectiveness

EPA expects that Corrective Measures will be cost effective. In 61FR19448, EPA established its remedial expectations as follows: "Treatment should be used to address the principal threats posed by a site whenever practicable and cost-effective". Cost effectiveness is determined by comparing the cost of all alternatives being considered with their overall effectiveness to determine whether the costs are proportional with the effectiveness achieved. In making this determination, the following definition was used: "A remedy shall be cost effective if its costs are proportional to its overall effectiveness." ((NCP §300.430(f)(1)(ii)(D)). "Overall effectiveness" was assessed by evaluating the Site Corrective Measures Alternatives – all of which have satisfied RCRA threshold criterion (i.e. protective of human health and the environment; attains media clean-up objectives; and controls the sources<sup>5</sup>). This involved the assessment of the three (3) effectiveness related criterion of the seven balancing criterion in combination (Long-term effectiveness; reduction in toxicity, mobility or volume of wastes; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness (See **Table 7.3-2** and **Table 7.3-4**).

<sup>4</sup> Pump and Treat Groundwater Remediation, A Guide for Decision Makers and Practitioners", EPA/625R-95/005, Section 5.1, Groundwater Barriers and Flow Control, page 28.

<sup>5</sup> "Control the source(s) of releases so as to reduce or eliminate, to the extent practicable, further releases of hazardous waste or hazardous constituents that may pose a threat to human health or the environment", **Handbook of Groundwater Protection and Clean-up Policies for RCRA Corrective Action**, EPA530-R-04-030, April 2004, page 4.1.

The pump & treat element of Alternative 3 has demonstrated reduction in toxicity, mobility or volume of wastes, equivalent to that which would be expected from Alternatives 4, 5 and 6. Alternatives 3, 4, 5 & 6 all have the potential for treatment of the wastes, given the TTDs in the MPA SWMUs. Alternative 3 has also demonstrated effectiveness in protecting human health and the environment over the long term, equivalent to that which would be expected from Alternatives 4, 5 and 6. Alternative 3 has much less short term risk than Alternative 4, 5 or 6. The estimated cost of Alternative 3 is much less than that of Alternative 4, 5 or 6. The relationship of overall effectiveness of Alternative 3 is therefore proportional to its costs and is deemed cost effective - representing a reasonable value for the money to be expended. Since Alternatives 4, 5 and 6 are estimated to be higher in cost and are equal or less effective alternatives, they are therefore not cost effective.

#### 7.3.3.4 Preference for Treatment as a Primary Element

EPA expects to use treatment to address "principal threats" posed by a site whenever practicable and cost effective. Contamination that represents "principal threats" for which treatment is most likely to be appropriate includes contamination that is highly toxic, highly mobile, or cannot be reliably contained, and that would present a significant risk to human health and the environment should exposure occur (61FR III.A.4.b -19448). The Site does not represent any "principal threats". Site contaminants have been contained successfully for over 20 years by the hydraulic containment system as demonstrated by periodic Site-wide monitoring of groundwater levels and gradients. However, Alternative 3 does employ a treatment technology development element (TTDs for ISCO and/or ISB) representing the potential to act as primary treatment for the reduction of sources of COIs which may contribute to groundwater contamination.

#### 7.3.4 CONSISTENCY WITH GUIDANCE

EPA's regulatory provisions for Corrective Action at permitted facilities are found primarily in 40 CFR Part 264 Subpart F. However, EPA provides additional direction on Corrective Action through guidance, policy directives and related regulations. EPA's **Handbook of Groundwater Protection and Clean-up Policies for RCRA Corrective Action**, EPA530-R-04-030, April 2004 (Handbook), is designed to assist regulators, members of the regulated community and the public in understanding EPA policies on protecting and cleaning up groundwater at RCRA Corrective Action facilities.

EPA's overall groundwater protection and cleanup strategy for RCRA Corrective Action with respect to cleanup of contaminated groundwater is: "(1) prioritize cleanup activities to limit the risk to human health first; and then, (2) restore<sup>6</sup> currently used and reasonably expected

<sup>6</sup> "The term "restore" or "restoration" used in this context refers to achieving a certain cleanup level(s) developed to ensure protection based on maximum beneficial use of the groundwater at a particular facility. Restoring contaminated groundwater does not necessarily imply cleanup to pristine conditions"

sources of drinking water and groundwater closely hydraulically connected to surface waters, whenever such restorations are practicable and attainable (EPA, 1991b)." (Handbook, pg. 1.2).

The approved CAOs and selected Site Point-of-Compliance, as well as the proposed media specific goals for the Site, acknowledge the need for long-term containment of the plume. In long-term containment situations, EPA recommends actions "...controlling sources...as a means to demonstrate progress toward achieving the overall mandate to protect human health and the environment (Handbook, pg 4.2). "When containment is part of a final remedy, facilities and regulators should develop systems to monitor the effectiveness of the containment" (Handbook, page 4.5). Performance monitoring is designed to demonstrate whether or not a Corrective Measure is performing as expected.

Corrective Measures Alternative 3 meets the guidance pursuant to the Handbook for groundwater at a long-term containment site. Human health is protected and migration of the sources is controlled by the Enhanced Site-wide Groundwater Containment and Treatment system preventing the potential for off-site migration into drinking water sources and confirmed by site-wide POC performance monitoring, site-wide groundwater level monitoring / gradient determination and drinking water supply monitoring at off-site locations. The environment is protected by the Enhanced Site-wide Groundwater Containment and Treatment system by preventing the potential for contaminated groundwater from entering the nearby hydraulically connected Ohio River. Development of site-specific ISB and / or ISCO technology is the most cost-effective approach to define a treatment for the sources capable of accelerating the reduction of contaminant levels as "expected" by guidance.

### **7.3.5 CONSISTENCY WITH PRECEDENT**

Thirty five (35) West Virginia RCRA Facilities in various stages of the Corrective Action process have been reviewed for comparison of Site recommended Corrective Measures with those taken at sites dealing with similar situations. None of the West Virginia sites have both environmental conditions comparable to Bayer and have selected final Corrective Measures that might inform the Bayer Corrective Measures selection process. While recognizing that states have primary responsibility for managing and protecting their groundwater resources, it may still be informative to compare Corrective Action at sites outside of West Virginia where similar environmental concerns have been addressed.

In a recent Region III action, EPA collaborated with Pennsylvania's Act 2 Land Recycling Program in achieving cleanup goals at the PECO facility in Chester. This facility was the former location of a resin manufacturing plant and hazardous waste recycler. The groundwater is contaminated by organic compounds and LNAPL, some of which discharged to adjacent surface water. The final remedy recognizes the technical limitations associated with groundwater restoration and establishes final cleanup goals for groundwater based on protection of surface water to which the plume discharges. The City of Chester code restricts

people from using the groundwater as a source of drinking water. This use restriction is an important component of institutional controls to prevent exposure to groundwater contamination for the final remedy. <http://www.epa.gov/reg3wcmd/ca/pa/pdf/pad000731026.pdf>.

Actions taken at the PECO site have been assessed by EPA to be consistent with the EPA Handbook on groundwater cleanup. Several site physical features, environmental contamination and recommended protective approach parallels exist between the PECO facility in Chester, PA and the Bayer Site:

- o Both are old industrial sites affording significant economic benefits to the local and regional communities;
- o Both have VOC and SVOC contamination of groundwater that discharges via a long waterfront (2600 feet for PECO) to a major river;
- o Cleanup goals acknowledge technical limitations and groundwater use at both sites, and focus on protection of surface water to which the plumes discharge;
- o Both sites rely upon pump and treat as a primary technology and monitoring to contain the plume and protect the river;
- o Both sites rely upon use restrictions as an important component of Institutional Controls.

Acknowledging that the State of West Virginia has primary responsibility for managing and protecting its groundwater resources, nevertheless, comparing the proposed actions for the Site to those developed at the PECO site indicates that the recommended Site Corrective Measures would lead to equivalent levels of protection that EPA would require if implementing the program.

#### 7.4 PROPOSED CORRECTIVE MEASURES IMPLEMENTATION SCHEDULE

Following is a preliminary implementation schedule for recommended Site-Wide Corrective Measures:

- CMS submittal to Agencies – July 2006
- Agency approval of CMS – October 2006
- CMS Implementation Work Plan bid, evaluation and award – December 2006
- CMS Implementation Work Plan and approval – March 2007
- CMS Pre-Design Investigation Studies and Final Corrective Measures Design – December 2007
- ✓ Groundwater Effectiveness Model design, approval and Implementation – July 2007
  - o Enhanced Site-wide Groundwater Containment and Treatment Design and approval - December 2007
  - o Performance Monitoring design and approval – December 2007

- ✓ SWMU Group A Perched Water Collection Trench design and approval – October 2007
- ✓ Tiered Technology Demonstration Design and approval – October 2007
- ✓ Institutional Controls Design and approval – October 2007
- Corrective Measures Implementation
  - ✓ SWMU Group A Implementation – January 2008 through September 2009
  - ✓ Institutional Controls Implementation – January 2008 through January 2009
  - ✓ MPA SWMUs Tiered Technology Demonstrations – January 2008 through 2013-2017
  - ✓ Enhanced Site-wide Groundwater Containment and Treatment – January 2008 – September 2009 and continuing.
  - ✓ Performance Monitoring – Installation January 2008 – April 2008. Begins May 2008 and continuing
- Corrective Measures Reporting
  - ✓ As approved

## 8.0 References

Dames and Moore, Evaluation of Existing Waste Disposal Facilities and Installation of a Groundwater Monitoring System in Accordance with RCRA Proposed Rules and Regulations, November 19, 1979.

Environmental Information Ltd. (EI), 367 Commercial Hazardous Waste Recycling, Treatment and Disposal Facilities Identified in North America ([www.envirobiz.com](http://www.envirobiz.com)), February 25, 2003.

Federal Remediation Technologies Roundtable (FRTR), Tri-Agency Permeable Reactive Barrier Initiative, Evaluation of Permeable Reactive Barrier Performance, December 9, 2002.

GAI Inc., Site Investigation of Proposed Solid Waste Disposal Site, New Martinsville Plant, Mobay Chemical Corporation, New Martinsville, WV, 1981.

Geraghty and Miller, Inc., Final Report: Hydrogeologic Conditions at the Mobay Chemical Corporation Plant Site, New Martinsville, WV, July, 1985.

Geraghty and Miller, Inc., Installation and Startup of Phase II Remedial Action Facilities, Mobay Chemical Corporation, New Martinsville, WV, July, 1986.

Geraghty and Miller, Inc., Procedures and Results of Investigation Required under USEPA Consent Order Docket #RCRA-III-004-AM, Mobay Chemical Corporation, New Martinsville, WV, April, 1988.

Green International, Monitor Well Installation and Soil Testing, Mobay Chemical Corporation, New Martinsville, WV, November 11, 1980.

ICF Kaiser, Description of Current Conditions for the Bayer New Martinsville Facility, February 1995.

IT Corporation, Final RFI Report for the Bayer Corporation New Martinsville, West Virginia Facility, Rev.1, December 2001.

Lu, Ming-Chun et al, Dechlorination of Hexachlorobenzene by Zero-Valent Iron, Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, Vol. 8, No. 2, April, 2004.

Mantha, et al, 2002 (TBD)

MFG Associates, Annual Groundwater Monitoring Report for 2003, March 2004.

Price, Paul H., and others, Geology and Economic Resources of the Ohio Valley in West Virginia, Volume XXII, West Virginia Geological and Economical Survey, Morgantown, WV, December, 1956.

Soil Conservation Service, US Department of Agriculture, Soil Survey of Marshall County West Virginia, Series 1957 No. 4, U.S. Government Printing Office, Washington, DC, May, 1960.

USEPA, RCRA Corrective Action Plan (Final), OSWER Directive 9902.3-2A, May 1994.

USEPA, Technology Innovation Office, Bioremediation of Chlorinated Solvent Contaminated Groundwater, August, 1988.

USEPA, Office of Research and Development, Office of Solid Waste and Emergency Response, Permeable Reactive Barrier Technologies for Contaminant Reduction, EPA/600/R-98/125, September, 1988.

USEPA, Industrial Use Designation Letter correspondence from Martin Kotsch, USEPA III, to Mary Ann Henderson, Bayer, August 2000.

USEPA, Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action, EPA530-R-04-030 April 2004.

Yang Mu et al, 2003 (TBD)